RESPONSE

The above amendments are made without prejudice. Reconsideration is respectfully requested.

Claims 13 and 30 have been amended to emphasize that the claimed method includes the active method step of cycling the pressure during the nitriding or carbonnitriding treatment in a pulsed manner by cyclically increasing the pressure for a certain period of time and then allowing it to drop to a lower level.

New independent claim 40 sets forth the steps of nitriding and carbonnitriding both the internal surface and the external surface of the pipe. As discussed on page 12 of the application at lines 10-20 and with reference to FIG. 2 the surface treatment of the external surface of the pipe is required due to the flexing stress being most evident in the region of the outer most layers of the pipe.

In addition, the new independent claim also requires the additional step, in combination, of subjecting the pipe to a pre-stressing process. As indicated on page 11, lines 19-23 of the patent application, this is advantageous in view of the action of the fluid pressure on the internal surface of the pipe.

This specific combination of treatment to a pipe is particularly beneficial when applied to pressurized fuel feed pipes or other tubular elements in a fuel injection system. Therefore, this claim and its dependant claims directed to this type of pipe.

Referring to claims 13 and 30 and their dependent claims, the method set forth clearly distinguishes the method disclosed in the Takei reference and relied upon by the Examiner. There the method taught is to reverse flow, and the equipment used employs two separate inlets/outlets (See FIGS. 2 and 3, items S_1 and S_2).

The Examiner suggests that Takei discloses using a pulsed gas method. Importantly, the Examiner acknowledges that it is a method that consciously reverses direction of flow. In this inventive process pressure is cycled, not direction of flow. Nowhere in the references is it taught to cycle pressure and in particular to increase it and then allow it to decrease. Claims 13 and 30 and their dependent claims should be allowed.

It must be pointed out that the Examiner's assumption that "reversed flow would inherently mean the pressure of the gas would change from pressurized to a vacuum" is directly contradicted by the Takei reference. At column 6, lines 16-19, it there states:

> "Also, an NH_3 gas pressure in the sealed box 2 is maintained slightly higher than that of the inert gas in the outer circumferential portion to thereby prevent inert gas or air from entering into the sealed box 2."

Thus, the Examiner's conclusion that a change in pressure would inherently result is unsupported. In any event, even if a change in pressure were inherent, the Takei reference does not teach the claimed affirmative steps of "increasing the pressure" and then "allowing it to drop to a lower level . . ."

Turning now to the specific rejections made by the Examiner, the following arguments are made. Though focused on the combination recited in new claim 40 the deficiencies of the prior art, in particular the patent to Asahi, also apply in the context of claims 13 and 30.

Kubo in View of Takei

Kubo discloses a method of producing high pressure fuel injection pipes for diesel engines which, in the case of FIG. 2, have hardened layers on the internal and external surfaces produced by nitriding. The Kubo process involves axially vibrating the pipes in a molten bath of sodium cyanide, and there is no suggestion of a nitriding process cyclically increasing and

decreasing the pressure of a controlled nitrogen or carbon and nitrogen atmosphere in the manner required by the independent claims. Furthermore, there is no suggestion in Kubo of using such a process in combination with a second process in which the pipe is stressed.

Takei discloses a method of nitriding materials by heating in a furnace and causing a flow of ammonia over the materials. To provide a uniform flow of gas over the materials, the method includes reversing the direction of the gas flow as described at column 6, lines 1-9. Therefore, Takei does disclose changing the direction of a gas flow during a nitriding process, but does not disclose puling the pressure of the gas as required by the independent claims. Furthermore, there is no suggestion of stressing the materials and no teaching of whether such stressing should take place before or after the nitriding process.

It is therefore believed that Kubo in combination with Takei fail to teach both pulsing of pressure of gas during the nitriding process, and pre-stressing of the pipe. Because optimum properties of a fuel injection pipe are obtained by these two processes, not taught by Kubo and Takei, the current independent claim 40 and its dependant claims are considered to be inventive over Kubo in view of Takei.

Kubo in view of Asahi

Asahi discloses a glow discharge surface treatment process wherein selected portions of a workpiece adjacent to or surrounded by an associated secondary electrode are surface treated so as to provide different treatments on the workpiece according to the position on the secondary electrode. As described in column 3, lines 23-53, the distance between the secondary electrode and the workpiece is preferable in the range of 2 to 25 millimeters, and the size of the secondary electrode is such that its surface area is substantially equal to or greater than the surface area of the workpiece. Consequently, it is not clear how such a process would be suitable for the

internal treatment of a small pipe as used in fuel injection systems. In the Asahi process both the workpiece and the secondary electrode are connected to the cathode (see the abstract) and consequently, it is not clear that providing a secondary electrode through the bore of a small pipe would in any way allow nitriding of the internal surface of the pipe to take place.

FIG. 15 referred to by the Examiner is described with reference to embodiment 5, an ion carburizing surface treatment, at column 10-12. In this process, there are alternating steps of carburizing at high temperature (above nine hundred degrees Celsius), at which the solubility of carbon to steel is large, and diffusing carbon inside the steel uniformly. For this purpose, a high temperature short time carburizing and subsequent diffusion process below nine hundred degrees Celsius are desirable, to prevent coarsening which leads to fragility (See column 11, lines 14-21).

At column 11, lines 29-37, Asahi suggest that in the reduced pressures that are used the gas pressure is varied to control the temperatures of the workpiece. This is stated more clearly in the final part of claim 1 of Asahi which states "the pressure of the treatment atmosphere being varied in the range of 0.1 to 10 Torr to control the treatment temperature." It, therefore, appears that the pulsing of the pressure in Asahi is provided to effect the variable heating of the workpiece. Because it is not clear from Asahi that the internal surface of a pipe may be processed using its method, there is no teaching in Asahi that pulsing of gas during nitriding or carbo-nitriding is useful for the treatment of the internal surface of a small pipe, such as a pressurized fuel pipe.

In conclusion then, it is not clear from Asahi that the internal surface of a small pipe could be nitrided or carbo-nitrided by the described process. Furthermore, because there is no clear teaching in Asahi of the processing of the internal surface of a pipe, there would be no

motivation for replacing the nitriding process of Kubo with one more similar to that disclosed by Asahi. This distinction is significant to claims 13 and 30, as well as new claim 40.

It should also be noted, that no reference to pre-stressing of a pipe can be found in either Kubo or Asahi as required by the current independent claims.

Independent claim 40 and its dependant claims are therefore considered to be inventive over Kubo in view of Asahi.

Yoshinori in view of Takei

Yoshinori discloses a method of manufacturing a high pressure fuel injection pipe comprising an outer pipe that is diametrically contracted onto an inner pipe. The inner pipe is processed to provide a nitrified layer on its internal surface only. Therefore, Yoshinori teaches that for a fuel injection pipe the inner surface only should be surface hardened. Takei discloses a nitriding process intended to nitride the processed material uniformly. There is no consideration in Takei of the specific requirements of a fuel injection pipe as determined by the radial and tangential stresses and axial stresses as described in the present application. Therefore, Yoshinori in combination with Takei does not produce any motivation for nitriding or carbo-nitriding the external surface of a fuel feed pipe. Because optimum results are obtained by nitriding both the internal and external surface of a fuel injection pipe, and Yoshinori in combination with Takei fails to teach this, the claimed invention is considered to be inventive over said combination.

Yoshinori in view of Asahi

As discussed above, the pulsing of the pressure within the system of Asahi is specifically linked to the specific glow discharge method described by Asahi in order to control the temperature of the workpiece. There is no suggestion in Asahi that the method is applicable to

the treatment of the internal bore of a small pipe such as a fuel injection pipe. Consequently, it is not clear from Asahi that its method could be used in manufacturing a fuel injection pipe such as that described by Yoshinori. Furthermore, it is believed that Asahi provides no motivation for using its method to treat the internal bore of a pipe rather than one of the methods suggested by Yoshinori. Also, there is not motivation provided by Yoshinori or Asahi to replace the nitriding process disclosed by Yoshinori with that disclosed by Asahi.

It should also be noted that there appears to be no teaching in Asahi of the surface treatment required by a fuel injection pipe as determined by radial and tangential stresses and axial stresses. Since Yoshinor teaches that a fuel injection pipe should be surface treated on its internal surface only, there is no teaching in Yoshinori and Asahi in combination that a fuel injection pipe should be nitrided or carbo-nitrided on its external surface. Because surface treatment on the external surface and the internal surface provides improved strength to the pipe, the currently claimed invention is considered to be inventive over Yoshinori in view of Asahi.

Favorable consideration of the pending claims is respectfully requested.

Respectfully submitted,

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